ESA-159-2, ArcelorMittal – Columbus, OH, Plant Public Report

Company	ArcelorMittal	**ESA Dates**	August 28th through August 30th
Plant	Columbus Coatings	**ESA Type**	Compressed Airt
Product	Primary Metals	**ESA Specialist**	M Dusty Smith, PE

Introduction:

The ArcelorMittal – Columbus Coatings, Columbus Ohio (Columbus Coatings) facility manufactures hot-dipped galvanized steel sheeting for use in the automotive and service sector industries. Three oil flooded single stage oil injected rotary screw compressors generate compressed air for the Columbus Coatings facility. All three compressors are 300 HP Quincy 1500's and air treatment equipment includes two 2,000 scfm rated desiccant dryers. Consumption of compressed air within Columbus Coatings is largely air cylinders, a small number of air operated cabinet coolers along with moderate use of air operated diaphragm pumps.

Objective of ESA:

The objective of this assessment is to train Columbus Coatings personnel to identify energy savings opportunities and subsequently quantify those opportunities using the DOE compressed air assessment tool AirMaster+.

Focus of Assessment:

The primary focus of this assessment is two fold; first to quantify energy consumption of the air compressors, and second to physically identify and catalog known inappropriate end uses, namely air operated coolers and air operated diaphragm pumps.

Approach for ESA:

The approach for this ESA can be characterized in series main tasks as follows:

- Pre-visit collection of aggregate energy consumption data, system description and system monitoring plan.
- Onsite kickoff meeting including an introduction to the ESA process and logistical review of onsite activities.
- Collection of monitoring data (flow, power and pressure) on each air compressor.
- Technical review and analysis of data along with data preparation for import into AirMaster+.
- System modeling and simulation of energy efficiency measures using AirMaster+.
- Review and report of findings.

General Observations of Potential Opportunities:

Columbus Coatings has a single compressor room where three identical Quincy 1500 compressors discharge in to two desiccant dryers which are configured in a parallel arrangement. Total capacity of the three compressors exceeds that of the two air dryers (4,500 acfm vs 4,000 scfm respectively). However, it appears that Columbus Coatings' air demand never exceeds the 4,000 scfm rating of the air dryers. In fact it is rare when all three compressors are running, and when three are operating, at least one is severely part loaded. None the less, vigilant observation is required to unsure that the dryer's combined capacity is not exceeded. The cost of exceeding the dryer's capacity is not only manifest in an elevated dew point but also in elevated discharge pressure at the compressors.

Two constituents of demand were of particular interest at Columbus Coatings, air operated cooling units or simply cabinet coolers and air operated diaphragm pumps. There exists many air operated diaphragm pumps within the facility, however all witnessed pumps seemed to be an appropriate use, pumping various chemicals on a largely intermittent schedule. As such, detailed cataloging of all air operated diaphragm pump was not performed.

Air operated cabinet coolers were believed to be extensively used throughout the facility by some personnel and not used at all by other personnel. Through exploration of the facility did in fact reveal a fair number of air coolers. The most widely used application is to cool small hydraulic units. While some small hydraulic units utilized more efficient traditional

refrigerated cooling many still used small ExAir vortex coolers. Other uses included typical electrical cabinet cooling and cooling of what appeared to be optical cameras. One use that is potentially appropriate is on the 'snout' where the ambient environment may not allow other forms of cooling. See Figure 1 for a table of cataloged air operated coolers.

Air Operated Cooling Units (cabinet coolers)		
Location	Required Air Flow (scfm)	Required Air Pressure (psig)
#2 & 3 Hydraulic Unit	10	85
#4 Hydraulic Unit	10	85
#6 Hydraulic Unit	10	85
#7 & 8 Hydraulic Unit	10	85
Snout	10	85
Panametric's Gas Analyizer Panel	25	85
GA Furnance Camera	10	85
GA Furnance Camera	10	85
Total	**95**	**85**

Figure 1. Air Operated Cooling, End Uses

Five individual energy savings opportunities were identified, two of which result in a decrease in compressed air demand. It should be noted that a reduction in compressed air demand may not result in the anticipated level of energy savings without proper control of the air compressors themselves. In fact AirMaster+ models this fact at Columbus Coatings well, showing little to no energy savings for compressed air demand reductions without first fully utilizing the existing compressor unloading controls. Please see Figure 2 for a summary of energy savings at Columbus Coatings.

Savings Summary For ArcelorMittal, Columbus Coatings								
Description	Energy Savings, kWh	Energy Savings, $	Energy Savings, %	Demand Savings, kW	Demand Savings, $	Est. Installed Cost, $	Total Savings, $	Simple Payback, years
Use Unloading Controls	84,142	4,039	2.2	2.2	0	500	4,039	0.1
Remove Cabinet Coolers	56,785	2,726	1.5	6.1	0	5,000	2,726	1.8
Replace Dryers with Refrigerat	203,331	9,760	5.4	20	0	50,000	9,760	5.1
Add Primary Receiver Volume	19,867	954	0.5	2.7	0	10,000	954	10.5
Tune Existing Sequencer	156,245	7,500	4.1	18.6	0	1,000	7,500	0.1
TOTALS	**520,370**	**24,978**	**13.7**	**49.6**	**0**	**66,500**	**24,978**	**2.7**

Figure 2. Savings Summary

Use Unloading Controls - Near Term Opportunity

The three Quincy compressors all have unloading controls but currently modulate heavily before the sequencer will unload them. The compressor's modulating control system and the sequencer unloading control system are completely separate systems and thus allow either intentional or more often unintentional overlap of compressor part load control set points. Simply increasing each compressor's modulating pilot valve set point pressure to above the sequencer's compressor unload set point will ensure each compressor operates at full load up to the unload pressure set point. Energy savings achievable through adjusting each compressors modulating pilot valve and thereby fully utilizing the efficiency of load / unload controls is 84,142 kWh.

Remove Cabinet Coolers – Medium Term Opportunity
Removal of air operated cooling units results in a compressed air demand reduction which in turn will result in energy savings at the compressor but also required energy consumption by the replacement cooling device. AirMaster provides a facility to account for this replacement cooling energy and in this case 3kW was estimated. Removal of seven of the eight identified coolers has been analyzed in AirMaster. It is believed that the 'snout' cooler is an appropriate end use and as such a demand reduction of 85 scfm rather than 95 scfm has been modeled in AirMaster. Energy savings achievable through removal and replacement of the remaining seven air coolers is 56,785 kWh.

Replace Desiccant Dryers with Refrigerated Dryers – Long Term
While winter temperatures do dip well below freezing in Columbus Ohio, the compressed air system at Columbus Coatings is indoor with only very few outside exposed valves or pipes that would require heat tracing. As such it is quite feasible that a 40 °F dew point capable refrigerated dryer would more than suffice for Columbus Coatings. More careful assessment of this opportunity during the cold winter months is recommended. Replacement of the desiccant dryers does save a significant amount of compressed air through purge air elimination but also incurs the cost of operating the refrigerated dryer. The demand savings as well as the cost to operate the new dryers were modeled in AirMaster, 203,331 kWh in savings were identified.

Add Primary Receiver Volume – Long Term
Current air storage capacity within the Columbus Coatings facility was estimated at 784 cubic feet (about 5,500 gallons) during a prior air study. This amount of storage is marginally adequate for proper load / unload control, industry best practice is to have 5 times the receiver volume in gallons of the capacity of the load / unload compressors. To realize the full benefit of load / unload control and to minimize unnecessary compressor starts by the sequencer and additional 2,500 gallons is recommended to be installed in or very near the compressor room. Energy savings achievable through the addition of 2,500 gallons of receiver volume is 19,867 kWh.

Tune Existing Sequencer – Near Term
Columbus Coating has and uses an older but functional automatic sequencer. Minor adjustment of this sequencer to take advantage of added receiver volume and properly adjusted modulating pilot valves on the compressors will result in significant energy savings. The sequencer should be tuned/adjusted such that it operates in a 'targeted' fashion, loading compressors at 75 psig and unloading them at 85 psig. Additionally, the sequencer should shut down compressors after 10 minutes of continuous running unloaded. Proper implementation may require some minor programming. Energy savings achievable through proper sequencer tuning is 156,245 kWh.